

1. A method for producing a high stability, low emission, invert fuel emulsion composition, comprising:

blending a flow of additives including a surfactant package with a flow of a hydrocarbon petroleum distillate fuel in a first in-line blending station to create a first composition, said surfactant package includes a primary surfactant, a block copolymer, and a polymeric dispersant, and said hydrocarbon petroleum distillate fuel is a continuous phase of the emulsion;

blending purified water with said first composition in a second in-line blending station to produce a second composition;

aging said second composition to produce an aged composition; and

passing said aged composition through a shear pump.

2. The method of Claim 1, wherein said aging is temperature dependent.

3. The method of Claim 1, wherein the emulsion is about 5 wt.% to about 50 wt.% of said purified water and about 50 wt.% to about 95 wt.% of said hydrocarbon petroleum distillate fuel.

4. The method of Claim 1, wherein said primary surfactant is about 3,000 parts per million to about 10,000 parts per million.

5. The method of Claim 1, wherein said primary surfactant is selected from a group consisting of nonionic surfactants, anionic surfactants, and amphoteric surfactants.

6. The method of Claim 1, wherein said primary surfactant is selected from a group consisting of unsubstituted, mono-substituted amides of saturated C<sub>12</sub>-C<sub>22</sub> fatty acids, unsubstituted, di-substituted amides of saturated C<sub>12</sub>-C<sub>22</sub> fatty acids, unsubstituted, mono-substituted amides of unsaturated C<sub>12</sub>-C<sub>22</sub> fatty acids, and unsubstituted, di-substituted amides of unsaturated C<sub>12</sub>-C<sub>22</sub> fatty acids.

7. The method of Claim 1, wherein said mono-substituted amides and di-substituted amides are substituted by substituents selected, independently of each other, from a group consisting of straight and branched, unsubstituted alkyls having 1 to 4 carbon atoms, straight and branched, substituted alkyls having 1 to 4 carbon atoms, straight and branched, unsubstituted alkanols having 1 to 4 carbon atoms, straight and branched, substituted alkanols having 1 to 4 carbon atoms, and aryls.

8. The method of Claim 1, wherein said primary surfactant is a 1:1 fatty acid diethanolamide of oleic acid.

9. The method of Claim 1, wherein said block copolymer is at about 1,000 ppm to about 5,000 ppm.

10. The method of Claim 1, wherein said block copolymer is an ethylene oxide/propylene oxide block copolymer.

11. The method of Claim 1, wherein said block copolymer is selected from a group consisting of an ethylene oxide/propylene oxide block copolymer having about 10 wt.% to about 40 wt.% ethylene oxide and an ethylene oxide/propylene oxide block copolymer having about 900 molecular weight to about 2,500 molecular weight propylene oxide.

12. The method of Claim 1, wherein said block copolymer is selected from a group consisting of an ethylene oxide/propylene oxide block copolymer having about 20 wt.% ethylene oxide and an ethylene oxide/propylene oxide block copolymer having about 1,700 molecular weight propylene oxide.

13. The method of Claim 1, wherein said polymeric dispersant is at about 100 ppm to about 1,000 ppm.

14. The method of Claim 1, wherein said polymeric dispersant is a non-ionic polymeric dispersant.

15. The method of Claim 1, wherein said emulsion comprises about 10 wt.% to about 50 wt.% of said purified water, about 50 wt.% to about 90 wt.% hydrocarbon petroleum distillate fuel, at least about 4,000 ppm amide primary emulsifier, about 200 ppm to about 3,000 ppm ethylene oxide/propylene oxide block polymer, and about 600 ppm to about 800 ppm polymeric dispersant.

16. The method of Claim 15, wherein said amide primary emulsifier is a diethanolamide of oleic acid.

17. The method of Claim 1, wherein the emulsion has an average droplet size of less than about 5 microns.

18. The method of Claim 1, wherein the emulsion has an average droplet size of less than about 1 micron.

19. The method of Claim 1, wherein the emulsion has an average droplet size of about 0.1 microns to about 1 micron.

20. The method of Claim 1, further comprising:

at least one component selected from a group consisting of lubricants, corrosion inhibitors, antifreezes, ignition delay modifiers, cetane improvers, stabilizers, and rheology modifiers.

21. The method of Claim 20, wherein said flow of additives comprises said surfactant package and at least one of said at least one component.

22. The method of Claim 20, wherein said flow of additives comprises a flow of said antifreeze and at least one of said at least one component blended in a third in-line blending station.

23. The method of Claim 1, wherein said purified water contains about 0.1 parts per million to about 50 parts per million of calcium ions, about 0.1 parts per million to about 50 parts per million of magnesium ions, and about 0.1 parts per million to about 20 parts per million of silicon.

24. The method of Claim 1, wherein said purified water contains about 0.1 parts per million to about 2 parts per million calcium ions, about 0.1 parts per million to about 2 parts per million magnesium ions, and about 0.1 parts per million to about 1 parts per million silicon.

25. The method of Claim 1, further comprising:  
adjusting pH of said purified water to a pH of about 4 to about 7.
26. The method of Claim 1, further comprising:  
adjusting pH of said purified water to a pH of about 5 to about 6.
27. The method of Claim 1, further comprising:  
adding a coupling agent formed into a water soluble salt to said flow  
of additives.
28. The method of Claim 1, wherein the emulsion is ashless.
29. The method of Claim 1, wherein said additives are selected to result  
in the emulsion being ashless
30. A high stability, low emission, invert fuel emulsion composition  
resulting from the method comprising:  
blending a flow of additives including a surfactant package and a  
flow of hydrocarbon petroleum distillate fuel to form a first composition in a first  
in-line blending station, said hydrocarbon petroleum distillate fuel is a continuous

phase of the emulsion, and wherein said surfactant package comprises a primary surfactant, a block copolymer, and a polymeric dispersant;

blending a flow of purified water to said first composition in a second in-line blending station to form a second composition;

aging said second composition to form an aged composition; and

passing said aged composition through a shear pump.

31. The emulsion composition of Claim 30, wherein said aging is temperature dependent.

32. The emulsion composition of Claim 30, wherein the emulsion is about 5 wt.% to about 50 wt.% purified water and about 50 wt.% to about 95 wt.% hydrocarbon petroleum distillate fuel.

33. The emulsion composition of Claim 30, wherein said primary surfactant is about 3,000 parts per million to about 10,000 parts per million.

34. The emulsion composition of Claim 30, wherein said primary surfactant is selected from a group consisting of nonionic surfactants, anionic surfactants, and amphoteric surfactants.

35. The emulsion composition of Claim 30, wherein said primary surfactant is selected from a group consisting of unsubstituted, mono-substituted amides of saturated C<sub>12</sub>-C<sub>22</sub> fatty acids, unsubstituted, di-substituted amides of saturated C<sub>12</sub>-C<sub>22</sub> fatty acids, unsubstituted, mono-substituted amides of unsaturated C<sub>12</sub>-C<sub>22</sub> fatty acids, and unsubstituted, di-substituted amides of unsaturated C<sub>12</sub>-C<sub>22</sub> fatty acids.

36. The emulsion composition of Claim 30, wherein said mono-substituted amides and di-substituted amides are substituted by substituents selected, independently of each other, from a group consisting of straight and branched, unsubstituted alkyls having 1 to 4 carbon atoms, straight and branched, substituted alkyls having 1 to 4 carbon atoms, straight and branched, unsubstituted alkanols having 1 to 4 carbon atoms, straight and branched, substituted alkanols having 1 to 4 carbon atoms, and aryls.

37. The emulsion composition of Claim 30, wherein said primary surfactant is a 1:1 fatty acid diethanolamide of oleic acid.

38. The emulsion composition of Claim 30, wherein said block copolymer is about 1,000 ppm to about 5,000 ppm.



39. The emulsion composition of Claim 30, wherein said block copolymer is an ethylene oxide/propylene oxide block copolymer.

40. The emulsion composition of Claim 30, wherein said block copolymer is selected from a group consisting of an ethylene oxide/propylene oxide block copolymer having about 10 wt.% to about 40 wt.% ethylene oxide and an ethylene oxide/propylene oxide block copolymer having about 900 molecular weight to about 2,500 molecular weight propylene oxide.

41. The emulsion composition of Claim 30, wherein said block copolymer is selected from a group consisting of an ethylene oxide/propylene oxide block copolymer having about 20 wt.% ethylene oxide and an ethylene oxide/propylene oxide block copolymer having about 1,700 molecular weight propylene oxide.

42. The emulsion composition of Claim 30, wherein said polymeric dispersant is about 100 ppm to about 1,000 ppm.

43. The emulsion composition of Claim 30, wherein said polymeric dispersant is a non-ionic polymeric dispersant.

44. The emulsion composition of Claim 30, wherein said emulsion comprises about 10 wt.% to about 50 wt.% of said purified water, about 50 wt.% to about 90 wt.% hydrocarbon petroleum distillate fuel, at least about 4,000 ppm amide primary emulsifier, about 200 ppm to about 3,000 ppm ethylene oxide/propylene oxide block polymer, and about 600 ppm to about 800 ppm polymeric dispersant.

45. The emulsion composition of Claim 44, wherein said amide primary emulsifier is a diethanolamide of oleic acid.

46. The emulsion composition of Claim 30, wherein the emulsion has an average droplet size of less than about 5 microns.

47. The emulsion composition of Claim 30, wherein the emulsion has an average droplet size of less than about 1 micron.

48. The emulsion composition of Claim 30, wherein the emulsion has an average droplet size of about 0.1 microns to about 1 micron.

49. The emulsion composition of Claim 30, further comprising:

at least one component selected from a group consisting of lubricants, corrosion inhibitors, antifreezes, ignition delay modifiers, cetane improvers, stabilizers, and rheology modifiers.

50. The emulsion composition of Claim 49, wherein said flow of additives comprises said surfactant package and at least one of said at least one component.

51. The emulsion composition of Claim 49, wherein said flow of additives comprises a flow of said antifreeze and at least one of said components blended in a third in-line blending station.

52. The emulsion composition of Claim 30, wherein said purified water about 0.1 parts per million to about 50 parts per million of calcium ions, about 0.1 parts per million to about 50 parts per million of magnesium ions, and about 0.1 parts per million to about 20 parts per million of silicon.

53. The emulsion composition of Claim 30, wherein said purified water contains about 0.1 parts per million to about 2 parts per million calcium ions,

about 0.1 parts per million to about 2 parts per million magnesium ions, and about 0.1 parts per million to about 1 parts per million silicon.

54. The emulsion composition of Claim 30, further comprising:  
adjusting pH of said purified water to a pH of about 4 to about 7.
55. The emulsion composition of Claim 29, further comprising:  
adjusting pH of said purified water to a pH of about 5 to about 6.
56. The emulsion composition of Claim 30, further comprising:  
adding a coupling agent formed into a water soluble salt to said flow of additives.
57. The emulsion composition of Claim 30, wherein the emulsion is ashless.
58. The emulsion composition of Claim 30, wherein said additives are selected to result in the emulsion being ashless.
59. A high stability, low emission, invert fuel emulsion composition for an internal combustion engine comprising purified water; hydrocarbon petroleum

distillate fuel as the continuous phase of the emulsion; and a surfactant package comprising primary surfactant, block copolymer, and polymeric dispersant, said emulsion being made by a continuous flow process comprising the steps of:

blending a flow of additives comprising said surfactant package and a flow of said hydrocarbon petroleum distillate fuel in a first in-line blending station;

blending a flow from the in-line blending station of said first blending step with a flow of said purified water in a second in-line blending station;

aging the composition from the second inline blending station of said second blending step in a reservoir; and

passing the aged composition from said aging step through a shear pump to a storage tank.

60. The invert fuel emulsion composition of claim 59 comprising 5-50 wt % purified water and 50-95 wt. % hydrocarbon petroleum distillate fuel.

61. The invert fuel emulsion composition of claim 59 comprising a surfactant fuel emulsion composition of at least 4000 ppm primary surfactant.

62. The invert fuel emulsion composition of claim 61 wherein said primary surfactant is an amide.

63. The invert fuel emulsion composition of claim 62 wherein said primary surfactant is selected from the group consisting of unsubstituted, mono- and di-substituted amides of saturated  $C_{12}$ - $C_{22}$  fatty acids and unsubstituted, mono- and di-substituted amides of unsaturated  $C_{12}$ - $C_{22}$  fatty acids, wherein said mono and di substituted amides are substituted by substituents selected, independently of each other, from the group consisting of straight and branched, unsubstituted and substituted alkyls having 1 to 4 carbon atoms, straight and branched, unsubstituted and substituted alkanols having 1 to 4 carbon atoms, and aryls.

64. The invert fuel emulsion composition of claim 63 wherein said primary surfactant is a 1:1 fatty acid diethanolamide of oleic acid.

65. The invert fuel emulsion composition of claim 59 comprising from about 1,000 ppm to about 5,000 ppm block copolymer.

66. The invert fuel emulsion composition of claim 65 wherein said block copolymer is an EO/PO block copolymer.

67. The invert fuel emulsion composition of claim 66 wherein said block copolymer is selected from the group consisting of PLURONIC 17R2, PLURONIC 17R4, PLURONIC 25R2, PLURONIC L43, PLURONIC L31, AND PLURONIC L61.

68. The invert fuel emulsion composition of claim 67 wherein said block copolymer is octylphenoxypolyethoxyethanol (PLURONIC 17R2).

69. The invert fuel emulsion composition of claim 59 comprising about 100 ppm to about 1,000 ppm 35 polymeric dispersant.

70. The invert fuel emulsion composition of claim 69 wherein said polymeric dispersant is ICI HYPERMER E-464.

71. The invert fuel emulsion composition of claim 59 comprising;

10-50% purified water;

50-90% hydrocarbon petroleum distillate fuel;

at least 4000 ppm amide primary emulsifier;

between about 200 and about 3000 ppm EO/PO block polymer; and

between about 600 and about 800 ppm polymeric dispersant.

72. The invert fuel emulsion composition of claim 71 wherein said amide primary surfactant is Schercomid SO-A (Scher Chemical).

73. The invert fuel emulsion composition of claim 71 wherein said block copolymer is Pluronic 17R2 (BASF).

74. The invert fuel emulsion composition of claim 71 wherein said polymeric dispersant is Hypermer E-464 (ICI).

75. The invert fuel emulsion composition of claim 59 wherein said emulsion has an average droplet size of less than about 5 microns.

76. The invert fuel emulsion composition of claim 75 wherein said emulsion has an average droplet size of about 1 micron or less.

77. The invert fuel emulsion composition of claim 76 wherein said emulsion has an average droplet size ranging from about 0.1 microns to about 1 micron.

78. The invert fuel emulsion composition of claim 59 further comprising one or more additives selected from the group consisting of lubricants; corrosion inhibitors; antifreezes; and ignition delay modifiers.

79. The invert fuel emulsion composition of claim 78 wherein said flow of additives of said first blending step is comprised of said surfactant package and said one or more additives.

80. The invert fuel emulsion composition of claim 79 wherein said flow of additives of said first blending step is comprised of a blended flow of a flow of an antifreeze and a flow of said additives blended in a third inline blending station.